

Undisturbed theatre dressing during the first postoperative week. A benefit in the treatment by external fixation: a cohort study

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Abstract In the literature, there are several different suggestions as to when the first postoperative pin-site care should be carried out to best prevent pin-site infections during the treatment by external fixation. In a cohort study, we compared the use of antibiotics and complications in patients where the theatre dressing was changed during the first postoperative week with patients where the theatre dressings were left undisturbed for the first postoperative week. Sterile compresses moistened with chlorhexidine 5 mg/ml in alcohol (70%), draped around each pin site and fixed by a bandage, were used as theatre dressing. In all patients, cultures were taken 1 week postoperatively from each pin site; use of antibiotics and complications during the treatment was documented. In 101 consecutive patients (118 knees) (73% men, mean age 50, mean BMI 27.5 kg/m²) operated on by high tibial osteotomy for knee deformity using the hemicallotasis technique, during 2005–2006, the theatre dressings were left undisturbed during the first postoperative week in 90 patients (104 knees) of group 1, and in 11 patients (14 knees) of group 2, the theatre dressings were changed during the first postoperative week. Eight of 11 patients in group 2 were treated with antibiotics compared to 32 of 90 patients in group 1 (RR 2.0, 95% CI 1.6–2.7, $p = 0.02$) during the treatment period by external fixation. Patients with a disturbed theatre dressing during the first postoperative week had an increased use of

antibiotics by 18.6 days (95% CI 10.6–26.5, $p < 0.0001$, adjusted analysis). Four of 11 patients in group 2 had complications and 11 of 90 in group 1, adjusted analysis (RR 2.7, 95% CI 0.4–16.2, $p = 0.3$). Bilateral surgery simultaneously showed increased use of antibiotics by 10.4 days (4.4, 16.4, $p = 0.0009$) and increased risk of complications (RR 5.8, 95% CI 1.2–27.5, $p = 0.03$). In conclusion, the increased use of antibiotics indicates that leaving the theatre dressing undisturbed during the first postoperative week is beneficial to the treatment by external fixation and is probably of importance in the prophylactic pin-site care.

Keywords Pin-site infection · Theater dressing · External fixation · Chlorhexidine · Pin-site care

Introduction

Pin-site infection is the most common complication when using external fixation. Such infection is painful, delays the mobilization, and can result in severe complications.

Pin-site care is one important part of the treatment by external fixation and includes the care of the wounds, where the pins and/or wires have been inserted, from the theatre dressing until the wounds are healed.

The purpose of pin-site care is to prevent pin-site infections. Pin-site care includes different factors such as theatre dressing, frequency of pin-site care, cleansing agent, removal of scab/crust, and dressing.

In the literature, there are several different recommendations when the first postoperative pin-site care has to be carried out, ranging from 24 h to 1 week postoperatively [1–7]. However, for how long the theatre dressing should be left undisturbed to best prevent pin-site infections

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during the treatment by external fixation is not known and previously not studied.

During 10 years, we have documented the pin-site care using clinical evaluation, bacterial culture, use of antibiotics, and complications in patients operated on by high tibial osteotomy using the hemicallotasis technique (HCO).

By changing the pin-site care successively from daily to once a week [6], using chlorhexidine instead of sodium chloride [8], and decreasing the use of prophylactic antibiotics [7] we have reduced pin-site infections and the use of antibiotics. The pin-site care developed from these studies is used in fracture healing and other corrections treated by external fixators.

From January 2005, we had patients coming to the first outpatient visit, 1 week postoperatively, with disturbed theatre dressing which had been very uncommon earlier. We also recorded more frequent positive bacterial cultures at week one.

The purpose of this study was to analyze if a disturbed theatre dressing during the first postoperative week affected the treatment in external fixation. We compared the use of antibiotics and complications during the treatment by external fixation in patients operated on by the HCO with an undisturbed theatre dressing with patients who had their dressing disturbed during the first postoperative week.

Materials and methods

Data on 118 knees in 101 patients (73% men) mean age 50 (range 16–69), operated on for knee osteoarthritis (97%) or other (3%) by the HCO, from January 2005 to December 2006 by one orthopedic surgeon (S. T. L.) were consecutively included in the study. The theatre dressings were left undisturbed during the first postoperative week in 90 patients (104 knees), and in 11 patients (14 knees) the theatre dressings were changed during the first postoperative week (Table 1).

Hemicallotasis osteotomy

The hemicallotasis was performed as an out-patient procedure using the Orthofix® T-garche as external fixator. Four pins, two of them HA-coated in the metaphyseal bone (OsteoTite Orthofix®) and two non-coated in the diaphyseal bone (Orthofix®), were inserted extra articularly. The method has been described previously [9, 10].

Pin-site care

The theatre dressing included sterile compresses, moistened with chlorhexidine (5 mg/ml) in alcohol (ethanol

Table 1 Patient characteristics of the study group ($n = 101$ patients)

	Undisturbed dressing ($n = 90$)	Disturbed dressing ($n = 11$)
Age (years)	50	52
(range)	(16–69)	46–63
Sex		
Men	65	9
Women	25	2
BMI (kg/m^2)	27.1	27.9
(range)	(20.4–34.9)	(24.1–31.2)
Medial/lateral OA (n)	77/13	10/1
Bilateral surgery simultaneously (n)	5	2

BMI body mass index, OA osteoarthritis



Fig. 1 Sterile compresses moistened with chlorhexidine 5 mg/mL in alcohol (ethanol 70%) as theatre dressing

70%) placed at each pin site, and fixed by a bandage (Fig. 1). The instructions are to leave the theatre dressing undisturbed during the first postoperative week except in cases of major leakage or suspicion of infection. In the first place the bandages should be strengthened (Fig. 2).

One nurse performed the pin-site care once a week in the orthopedic outpatient clinic.

Clean technique (sterile material and clean gloves) was used. All bandages were removed. Each pin site was cleaned by chlorhexidine (5 mg/ml) in alcohol (ethanol 70%). No crusts were removed unless signs of infection perceived. A sterile compress, moistened with chlorhexidine (5 mg/ml) in alcohol (ethanol 70%) was placed at each pin site and was fixed by a soft dressing around each pair of pins. When showering, the patient protected the pin sites using a plastic bag. The patients had full access to the outpatient clinic if they had questions or any problems occurred. In the case of pin-site infection or drainage, extra visits were made if needed.



Fig. 2 Undisturbed theatre dressing one week postoperatively

Bacterial culture

Bacterial culturing using a thin cotton culturing pin (for nasopharynx culturing use) was taken from each pin site at the first postoperative week.

Antibiotics

No prophylactic antibiotics were used. Flucloxacillin 1g \times 3 or the antimicrobial drug susceptible for the positive culture was used for 7 days as antibiotic treatment during the treatment period in case of infection.

Outcome

Use of antibiotics (number of patients and days/treated patient) and complications during the time of external fixation were used as primary outcomes. Complications including delayed healing (defined as >112 days in external fixation), non-union, septic arthritis, infection of the surgical incision site, deep venous thrombosis, loss of correction, and other complications (including replacement of pins and difficulties of correction) were compiled. The use of antibiotics was obtained weekly.

Statistical analysis

ANOVA, Fischer's exact test, and χ^2 test were used for statistical analysis.

The influence of seven potential predictor variables on use of antibiotics (days per treated patient) was analyzed by means of linear regression analysis [(sex, age, Body Mass Index (BMI kg/m²), disturbed/undisturbed theatre dressing, time in external fixation size of correction (preoperative Hip-Knee-Ankle angle) and bilateral surgery simultaneously). The influence of six potential predictor

variables on complications was analyzed by Cox regression [11] (sex, age, BMI kg/m²), disturbed/undisturbed theatre dressing, size of correction (preoperative Hip-Knee-Ankle angle), bilateral surgery simultaneously, smoking and use of snuff). The statistics software Stat View for Windows version 5.0 (SAS Institute Inc., Cary, NC) was used. *P* value <0.05 was considered as statistically significant.

The study was approved by the Ethics Committee, Lund University, Sweden.

Results

Nine of 11 patients with a disturbed theatre dressing during the first postoperative week had positive bacterial culture compared to 3 of 90 patients with an undisturbed theatre dressing RR 24.5 (95% CI 9.3–50, *p* < 0.0001).

The theatre dressings were disturbed during the first postoperative week for different reasons (Table 2). *Staphylococcus aureus* were present in seven of the nine patients with positive bacterial cultures. Four of nine patients had additional one or more of bacterial growth and were redressed in the patients home (Table 2). In three patients with undisturbed theatre dressings who had positive bacterial cultures, the cultures showed Coagulase-Negative *Staphylococcus*.

Eight of 11 patients with a disturbed theatre dressing were treated with antibiotics compared to 32 of 90 patients with undisturbed dressings (RR 2.0, 95% CI 1.6–2.7, *p* = 0.02) during the treatment period (mean 85 ± 14 days) by external fixation. The mean time in external fixation was 84.5 ± 13.1 days in patients with undisturbed theatre dressing and 85.2 ± 12.6 days in patients with disturbed theatre dressing. The average number of days with treatment by antibiotics was 28 days (SD 23) per treated patient with disturbed theatre dressing and 12 days (SD 11) per treated patient with undisturbed theatre dressing (*p* < 0.0007). The adjusted analysis showed that in patients with disturbed theatre dressing during the first postoperative week the use of antibiotics per treated patient lasted for 18.6 days (95% CI 10.6–26.5, *p* < 0.0001). Four of 11 patients with disturbed theatre dressing and 11 of 90 patients with undisturbed theatre dressings had complications (RR 3.1, 95% CI 1.2–6.7, *p* = 0.03) adjusted analysis (RR 2, 95% CI 0.8–5.2, *p* = 0.1). Patients who had bilateral surgery simultaneously showed more use of antibiotics lasting for 10.4 days (4.4, 16.4, *p* = 0.0009) and had increased risk of complications (RR 3.5, 95% CI 0.99–12.3, *p* = 0.05; Table 3).

Table 2 Reason for disturbance of the theatre dressing during the first postoperative week and bacteria of positive culture ($n = 11$)

Patient	Reason for disturbance	Bacteria
1	Bleeding through, changed in postop unit	<i>Staphylococcus aureus</i>
2	Bleeding through, changed at home	
3	Bleeding through, changed at home	<i>Staphylococcus aureus</i>
4	Major bleeding, changed at home	Beta-streptococcus group G miscellaneous gram-positive flora
5	Bleeding through, changed at home	<i>Staphylococcus aureus</i> Beta-streptococcus group G
6	Major bleeding after falling, changed in nursing ward	<i>Staphylococcus aureus</i>
7	Bleeding through, changed at home	<i>Staphylococcus aureus</i> <i>Enterobacter cloacae</i> <i>Bacillus art</i>
8	Bleeding through, changed at home	
9	Bleeding through, changed in postop unit	<i>Pseudomonas</i>
10	Bleeding through, changed at home	<i>Staphylococcus aureus</i> <i>Pseudomonas</i>
11	Bleeding through changed, in postop unit	<i>Staphylococcus aureus</i>

Table 3 Complications (patients)

	Undisturbed dressing ($n = 90$)	Disturbed dressing ($n = 11$)
Septic arthritis	1	1
Surgical incision site	0	2
DVT	1	0
Delayed healing	3	0
Loss of correction	1	0
Other*	5	1

* including replacement of pins and difficulties of correction

Discussion

The time to the first postoperative pin-site care has been reported in some studies including pin-site care [1–7] and among these there are studies that highlighted the importance of an early postoperative pin-site care to minimize the risk of infection [1, 5, 12]. However, the reason for early postoperative pin-site care is scantily described and to our knowledge not previously studied.

With an undisturbed theatre dressing during the first postoperative week the use of antibiotics was the same in this study as in our earlier studies using the same method of pin-site care with chlorhexidine and pin-site care once a week [7, 8]. In the present study, the patients did not receive any prophylactic antibiotics as in previous studies [7, 8]. Most of the patients with disturbed theatre dressing during the first postoperative week needed antibiotic treatment during the time of external fixation and used more of antibiotic using the same method of pin-site care. This indicates that the time of the first postoperative

pin-site care is an important factor in the prevention of pin-site infection.

That patients coming on the first outpatient visit, 1 week postoperatively, with disturbed theatre dressing had been very uncommon before as well as positive bacterial cultures at week one since we started using chlorhexidine moistened compresses as theatre dressings. The instruction is to not disturb the theatre dressing unless there is major leakage or suspicion of infection. It is not unusual with some bleeding through the dressing immediately postoperatively. However, a bleeding that stopped but left visible dried blood through the dressing is no reason for re-dressing unless suspicion of infection. The instructions are based on our clinical experiences and our studies that it is uncommon with infections during the first postoperative week when we use chlorhexidine in the theatre dressing. Two of the patients had their theatre dressing disturbed during the first postoperative week due to major bleedings and it was necessary to change dressings. However, in the rest of the patients with disturbed theatre dressing, there was no known reason for change of dressing according to the instructions. The pin-site protocol based on our studies includes that sterile technique should be used if the pin-site care needs to be performed in the nursing ward and to use clean technique in the outpatient clinic and in the patient's home. Sometimes it will be necessary to change the theatre dressing during the first postoperative week due to major leakage. Considering the results of this study, it could be suggested that the pin-site care during the first postoperative week should be performed with sterile technique regardless of location.

When adjusted the results for potential confounders', bilateral surgery simultaneously showed to be a risk factor

for both pin-site infection and other complications. These results may be explained by the double risk of exposure as the number of patients is used instead of number of knees in the analysis.

In the analysis, complications included all other complications except pin-site infections, which may explain how the increased risk of complication with an undisturbed theatre dressing during the first postoperative week could be explained by other factors.

Positive bacterial cultures do not mean that there is an infection but a low frequency of positive bacterial cultures indicates a decreased risk of infections. Most of the patients with disturbed theatre dressing during the first postoperative week had positive bacterial cultures.

This indicates that leaving the theatre dressing undisturbed decreased the risk of wound contamination. An explanation to the low frequency of positive bacterial cultures may be the antibacterial effect of chlorhexidine and its quality to bind to younger cells of the skin and thereby delay the bacterial re-growth [13], together with an undisturbed dressing. This combination could be suggested as not only a good start of the treatment but has also an effect of the treatment as a whole.

The use of antibiotics was chosen as the primary outcome of pin-site infection due to that the use of antibiotics during the time in external fixation reflects the problem of pin-site infection. Low consumption of antibiotics during the treatment in external fixation indicates a low incidence of pin-site infection. The need and use of antibiotics in combination with complications may be a more proper outcome reflecting a specific factor such as, e.g., frequency of pin-site care or a concept of a pin-site care on pin-site infection. The most common outcome is clinically evaluated pin-site infection. There are several different clinical definitions and classifications of a pin-site infection described in the literature; however, none of them are valid [14–16]. The evaluation of clinical pin-site infection as a primary outcome is subjective and with additional grading of the infections the evaluation become even more subjective. We have also experienced that clinical evaluations of pin sites are an insensitive outcome, i.e., an intervention that showed highly significant differences in positive bacterial cultures and use of antibiotics but no differences in clinical pin-site infections according to the Checketts Otterburns classification [6, 8].

To compile the use of antibiotics both as prophylaxis and treatment, oral and intravenous, in studies regarding pin-site infection is important to evaluate the effect of a pin-site care. The prescription of antibiotics may also be seen as a subjective outcome. However, a restrictive use of antibiotics may result in more complications.

Pin-site infection is a disadvantage using external fixation and it could be discussed if internal fixation is a more preferable alternative. However, external fixation offers several advantages; stability in severe comminute fractures where other methods should fail. Bone reconstruction with external fixation is one of few techniques that could be used in progressive bone lengthening and correction of deformities. The possibility to operate on several levels and over joints allowed extensive correction, mostly with only one operation. In the few studies comparing high tibial osteotomy with the closed wedge and the open wedge techniques the clinical results are equivalent. Studies comparing the closed wedge and the open wedge techniques with internal fixation show the advantages of the closed wedge technique with archived and maintained correction and less risk of complications [17, 18]. When comparing the closed wedge technique with the hemicallosal technique, the hemicallosal technique show advantages of archived and maintained correction and less risk of complications [19].

The strength of present study is the uniform study group with a standardized surgical procedure and the frequency and regularity of the follow-up during the treatment. HCO is a procedure with high demands on pin fixation due to early weight bearing and knee flexion combined with forces for the angular correction and thereby including several risk factors of pin-site infection. A stable fixation is a prerequisite for any type of treatment with external fixation; otherwise alternative treatment may be considered. Further, it is necessary with a homogenous study group, when studying a specific factor of the pin-site care, to enhance the possibility to measure what is intended to be measured; the effect on pin-site infection by different interventions in purpose to minimize the infection problem. A case mix of patients with different causes of treatment, locations, number of pins and wires and time in external fixation, etc. (i.e., different risk of pin-site infection) makes it difficult to control for external factors that could confound the results.

The limitation of a cohort study is the lack of randomization. However, the benefit of a cohort study is the possibility to study factors that might be important in the context such in present study. We have left the theatre dressings undisturbed during the first postoperative week based on the theory that the less you disturb the less risk of contamination for several years, but not reflected over how this specific factor of the pin-site care affects the treatment as a whole. The present study may include valuable information to be used in the design of a randomized study.

The conclusion of this study is that an undisturbed theatre dressing during the first postoperative week is a benefit in the treatment by external fixation and probably

also an important piece of the puzzle in the prophylactic pin-site care.

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